

NASA TECH BRIEF

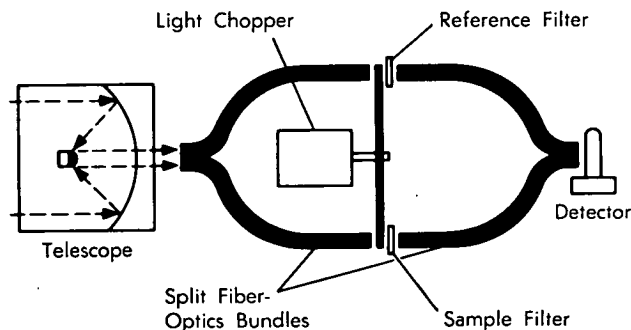
Ames Research Center



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Assessment of Water Pollution by Airborne Measurement of Chlorophyll

Airborne methods for detection of pollution in natural bodies of water primarily are based on measurement of changes in water color. The color changes may yield information on the location and extent of



algal blooms, the intensity of silting, and the distribution of chemical effluents. However, specific pollutants can not be sensed directly; for example, nitrates, phosphates, mercury compounds, or DDT can not be sensed, but it may be possible to infer the presence of nutrient or toxic substances by studies of their effects on the color of a body of water.

Photosynthesis is the common link in the marine and land food chain, and it is the only significant process by which solar radiation is converted into life-supporting substances. In bodies of water, regions of photosynthetic activity are associated with surrounding areas of zooplankton and marine life; however, as the level of nutrients increases, or if the dispersal and flushing action of the body of water is low, photosynthesis may create dense growths of algae which can have a severe impact on other marine life.

All methods for measuring the rate of photosynthesis in a water body require contact of a sensor with the water, or that certain measurements be made on the water. However, since all major photosynthetic processes require the presence of chlorophyll, and it has been established that there is a correlation between chlorophyll mass and primary productivity in marine surface waters, the concentration of chlorophyll can be used directly as an indicator of basic biological processes and as a delineator of the extent and effects of water pollution. Hence, remote measurement of chlorophyll concentrations provide valuable insight for pollution studies.

An airborne chlorophyll correlation radiometer has been devised to measure the chlorophyll content of water bodies such as freshwater lakes and estuaries as well as extended coast lines which characteristically exhibit interaction of plumes from rivers and bays with ocean water. As indicated in the diagram, the radiometer consists of an entrance fiber-optics bundle split into two parts, an optical chopper, sample and reference filters, and a photomultiplier tube with S-10 response characteristics. A phase-lock amplifier phased by a signal from the optical chopper permits comparison of the intensity of the sample and reference light bundles at a frequency of 1 kHz, and an automatic gain control system compensates for variations in the intensity of sunlight falling on the body of water.

The radiometer is mounted on an aircraft so that it can have a downward look at the surface of the body of water. The radiometer output represents the intensity of upwelling sunlight in the spectral region

(continued overleaf)

centered about 443 nm with reference to the region centered at about 525 nm, and laboratory tests have demonstrated that the radiometer output is related to the chlorophyll content of water. The simultaneous determination of water surface temperature is also desirable inasmuch as many water outflows and processes associated with the introduction of nutrients or pollutants can also appear as differences in water temperature. A commercially available radiometer is used to obtain airborne indications of temperature.

The ability to make measurements quickly from an aircraft over a large area and to have the results available immediately for real-time analysis make the technique described above especially useful for pollution studies.

Note:

Requests for further information may be directed to:
Technology Utilization Officer
Ames Research Center
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Reference: TSP 72-10566

Patent status:

NASA has decided not to apply for a patent.

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